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UNCLASSIFIED FAA-RD-77-63 NL

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Report No. FAA-RD-77-63

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SUPPORT CONTRACTOR TASKS FOR APPLYING THE INTEGRATED NATIONAL AIRSPACE COMMUNICATION SYSTEM (INACS) CONCEPT TO FAA TELECOMMUNICATIONS SYSTEM

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APRIL 1977

FINAL REPORT

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Systems Research & Development Service
Washington, D.C. 20590

NOTICE

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FAA-RD-77-63		

4. Title and Subtitle
Support Contractor Tasks for Applying the Integrated National Airspace Communication System (INACS) Concept to FAA Telecommunications System,

5. Report Date
April 1977

6. Performing Organization Code

7. Author(s)
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8. Performing Organization Report No.
14 P.

9. Performing Organization Name and Address
ACLS Corporation
6900 Wisconsin Avenue
Chevy Chase, Maryland 20015
410252
New

10. Work Unit No. (TRAIS)

11. Contract or Grant No.
WI-77-5423-1
new

12. Sponsoring Agency Name and Address
Department of Transportation
Federal Aviation Administration
Systems Research and Development Service
Washington, D.C. 20590

13. Type of Report and Period Covered
Final Report.

14. Sponsoring Agency Code
ARD 221

15. Supplementary Notes

16. Abstract

The report contains general comments about the Integrated National Airspace Communication System (INACS) Concept, guidelines for a support contract and contractor evaluation, and tasks to be included in a Statement of Work (SOW) for a support contractor.

17. Key Words	18. Distribution Statement
Telecommunication, INACS	Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	15	

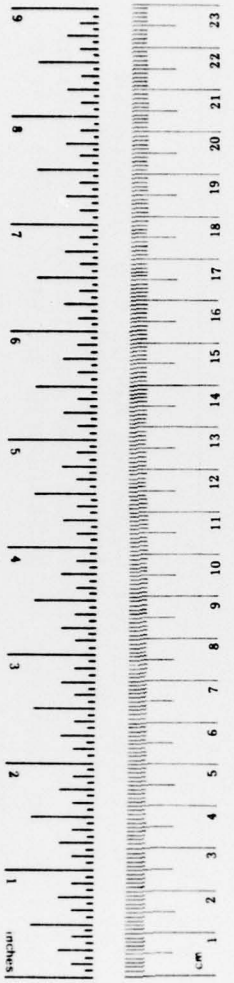
410252

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

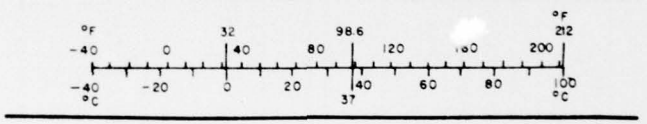
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in. = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



1. INTRODUCTION

It has been apparent for a number of years that the FAA's voice, radio and data communication equipment is obsolescent. Reliable services to users have been maintained as a result of the high esprit de corps of government and common carrier technicians and the availability of spare parts. Because of the reliable service, there is little pressure to replace the current hardware.

In addition the telecommunications system that has evolved has grown in support of separate FAA services, is often inefficiently utilized and provides overlapping capabilities. The separate and dedicated communications for Air Route Traffic Control Centers (ARTCC) and Flight Service Stations (FSS) for example is more expensive than it need be.

An overall plan to improve and update the complete telecommunications network was dubbed INACS (Integrated National Airspace Communication System). A number of reports as listed below were prepared in support of an INACS procurement.

a. INACS for the Support of ATC Operations in the 1980s and 1990s--System concept (FAA-INACS-061-221-SC-Sept. 8, 1975)

b. INACS Gross Cost/Benefit Analysis (FAA-INACS-061-221-CB-April 15, 1976)

c. INACS Operational/Maintenance Requirements (FAA-INACS-061-221-OR-July 11, 1975)

d. RCCS Preliminary System Description-March 3, 1977 (DRAFT)

e. INACS System Program Plan (FAA-INACS-061-221-PP-Feb. 18, 1977)

A review of these reports and others revealed that INACS is not a single entity and cannot be purchased as such. These findings are enlarged upon in the body of this report.

INACS reports identify four subsystems, namely, voice communications subsystem, (VCS), radio communications subsystem (RCS), data communications subsystem (DCS) and technical control subsystem (TCS). The latter which involves control, monitoring and diagnostics has several other titles. This report points out that control, monitoring and diagnostics are basic requirement for the voice, radio and data telecommunications networks and should not be considered as a separate subsystem. This is not to say that hardware and software for control, monitoring and diagnostics should not be common to the three modes of communications. It should.

This report attempts to dispel the opinion that FAA is going to go out and buy one or more INACS. Voice, radio, and data systems are telecommunications systems which should be procured under an INACS architectural umbrella or plan. The plan would increase reliability and maintainability and provide economies by replacing vacuum tubes and mechanical switching with state-of-the-art solid state circuitry and switching. Standard modules and shared leased lines would be used for voice, radio and data networks. Centralized control, monitoring and diagnostics could reduce the ever increasing need for highly qualified technicians.

Very rapid and continuing advances in telecommunications system technology have taken place since the Carterphone Decision, the advent of high-speed data communications and the burgeoning use of satellite telecommunications service. Most large telecommunications systems are being modernized. This includes the Bell System, other common carriers, the World-Wide Military Command and Control System (WWMCCS), microwave links and early satellite systems. The Bell System alone is spending millions of dollars to replace obsolescent equipment.

The new telecommunications system technology exists and is available from several sources--even the Bell System is buying some

competitively made equipment. Reliability available from solid state leased line terminal equipment suggests that it may be more cost effective to purchase rather than lease the bulk of the terminal equipment. These decisions must be made by the FAA with the support of an INACS Architecture contractor. It would be well to select a contractor that is willing to consider both lease and purchase approaches to the systems architecture.

2. INACS CONCEPT--GENERAL CONCLUSIONS AND RECOMMENDATIONS

a. Conclusions

(1) INACS is a concept or framework under which current, modified and new modular type telecommunications hardware and software may be linked to improve the service to users, increase telecommunications reliability and reduce the cost of operations and maintenance. INACS embraces all FAA telecommunications incident to air traffic control, flight services and remote operation of navigation aids. Key to the INACS concept is:

- More efficient use of interconnecting telephone circuits by reduction of interconnect location and by multiplexing services.
- Increasing system reliability by replacing vacuum tubes and electromechanical switching with state-of-the-art solid state and electronic switching hardware.
- Establishing a family of standard assemblies and modules applicable to radio, voice and data circuits for all services.
- Adding centralized management and maintenance circuits to control, monitor and diagnose the total telecommunications network.

(2) The INACS concept must be loose enough to embrace the current system, new technology available now, and technology which may develop in a 15 year transition period.

(3) The INACS concept requires an implementation plan which permits new modular hardware to be phased in without disruptions of the present system and without an undue strain on the budget.

(4) Proof of the INACS concept can be demonstrated by implementation of any one area of telecommunications, i.e., radio, voice or data with features set forth under technical control. RCCS for FSS could provide proof of the INACS concept.

(5) INACS concept benefits derive from sharing interconnects, control and monitoring, and hardware in the three areas of telecommunications, i.e., radio, voice and data. The sharing of interconnects is based on a central system of telecommunications such as combinations of radio, voice and data within a facility or between colocated facilities

(6) The development and implementation of the INACS concept will require an understanding of political problems.

(a) Controller and pilot user groups will generally resist changes. The present FAA telecommunications system, while costly to operate and not as reliable as current technology will permit, are considered satisfactory to both user groups. Statements that expansion of the present systems to meet future growth in the number of flight operations would be costly, do not impress either user group.

(b) To obtain controller and pilot support for the INACS concept, the FAA must prove that an expansion based upon more of the present equipment will reduce service or that by installing INACS equipment both user groups will receive much better service than they currently do.

(c) Most of the pilot contact with FAA is through flight service and radio; hence improvement in these services will promote and justify INACS concept expenditures.

b. Recommendations

(1) Identify INACS as a broad architectural concept applicable to all telecommunications rather than specifically with any one program such as RCCS or NADIN.

(2) Treat TCS as common to all telecommunications systems, i.e. radio, voice and data, rather than as a separate system.

(3) Support the INACS concept on the basis of expanded telecommunications systems potential, reliability and maintainability vice cost savings.

(4) Justify using ARTCCs for example, as telecommunications centers for FSS, ATCT, TRACONS, etc., on the basis of existing interconnects and plant investment.

(5) Produce a document which relates the currently planned RCCS program to the INACS concept and describes the INACS fall out from the RCCS program that will contribute to ARTCC, TRACON and ATCT communications enhancement needs.

3. GUIDELINES FOR SUPPORT CONTRACT AND CONTRACTOR EVALUATION

a. Best contractor support can be obtained by a competitive award as soon as possible. Contract should be for one year with option for renewals.

b. Contractor experience must include:

(1) Knowledge of current telecommunications systems.

(2) Knowledge of state-of-the-art telephone, data communications, system control, monitoring and diagnostic equipment, time sharing and multiplexing.

(3) Understanding of Common Carrier problems with peripheral manufacturers and merits of arguments.

(4) Knowledge of existing telecommunications systems interface standards and specifications and capability to prepare new standards and specifications.

c. If the support contractor is also a telephone operating company then some controls must be applied to the support contractor such as:

(1) Require subcontracting of a portion of terminal and switching equipment architecture.

(2) FAA should have veto over subcontractor selection or FAA provide lists of suitable subcontractors.

d. The Statement of Work for the support contractor should provide tasks only in general areas. Specific tasks as and when needed to be approved by FAA and accepted by the contractor.

e. Analyses, studies, models, etc. necessary to justify the INACS should be performed in house or by some contractor(s) other than the support contractor. While these efforts are important and must be done to justify the concept

they could detract from the effort of the support contractor necessary to move ahead with the INACS program. The Statement of Work for the support contractor should not include:

(1) Cost benefit analyses.
(2) Traffic sizing studies.
(3) Radio coverage studies.
(4) System modeling.
(5) Budgetary cost models.
(6) Validation studies.

4. STATEMENT OF WORK FOR SUPPORT CONTRACTOR

The Contractor shall provide support and engineering services to the FAA, during the development phase of the INACS concept (See FAA-INACS-061-221-SC), in accordance with the specific task assigned. Tasks shall be assigned as specified below, in the following areas:

a. Review available INACS Documentation.

(1) INACS for the Support of ATC Operations in the 1980s and 1990s--System concept (FAA-INACS-061-221-SC-Sept. 8, 1975)

(2) INACS Gross Cost/Benefit Analysis (FAA-INACS-061-221-CB-April 15, 1976)

(3) INACS Operational/Maintenance Requirements (FAA-INACS-061-221-OR-July 11, 1975)

(4) RCCS Preliminary System Description-March 3, 1977 (DRAFT)

(5) INACS System Program Plan (FAA-INACS-061-221-PP-Feb. 18, 1977)

(6) Communication Requirements for the FS Baseline Systems-Jan. 5, 1977 (DRAFT)

(7) FAA Communications Systems Description (1973)(FAA-RD-73-30-Feb. 1973)

b. Establish a telecommunications Systems Architecture and Design Plan that embraces the INACS Concept (radio, voice, data, network control, monitoring and diagnostics) for current systems and others such as RCS (RCCS and A/G Radio System), and NADIN.

(1) Make lease versus buy studies for each communication area (radio, voice, data) which are consistent with development, prototype and production phases.

(2) Perform voice, radio and data communications common usage trunk connectivity studies and prepare optimized network configuration designs as part of the technical control function.

(3) Prepare optimized facility configuration designs.

(4) Determine new hardware/software module developments required.

c. Prepare an Engineering and Development Program Plan to support telecommunications systems architecture.

(1) Alternative approaches.

(2) Selected technical approach(es).

(3) Relation to other developmental programs in FAA.

(4) T&E activities.

(5) Expected end products.

(6) Scheduling detail for development cycle.

(7) Resource levels required.

(8) Major milestones for development cycle.

(9) Potential risk factors impacting procurement.

(10) Training needs.

(11) Operational, maintenance, regulatory procedures revision.

d. Review standards and Interface Control Documents (ICDs) applicable to current FAA telecommunications systems, determine impact of required changes for the new architecture and prepare revised or new standards and ICDs for current and future systems.

e. Evaluate and document the cost of technical trade-offs between utilizing current commercial, military or other government systems on state-of-the-art developments.

f. Prepare the Acquisition Paper for the development phase of the INACS concept (FAA Order 4405.7)

   (1) Scope of planned acquisition

   (2) Detail overall program

   (3) Procurement strategy

g. Prepare design and engineering requirements for demonstration hardware and software with maximum use of off the shelf.

h. Prepare functional and system descriptions for demonstration hardware and software.

i. Prepare demonstration plan for proving out systems architecture for hardware and software.

j. Observe and validate the formal testing performed in plant and on-site, to include reviewing of test plans, witnessing the performance of the test, confirming the data derived, examining the results for compliance with the applicable specifications and test requirements.

k. Prepare a technical data package for applying the INACS concept to such telecommunications systems that can be made compatible as RCCS and NADIN.